Specification

Cylinder Pertaining to a Folder Comprising a Cylinder Body and at Least One Gripper

The invention relates to a cylinder of a folding apparatus, having a cylinder body and at least one gripper, in accordance with the preamble of claims 1 or 2.

Such a gripper cylinder has one or several grippers on its shell face, which are movable between a position in which they keep a leading edge of a piece of flat material, which is to be conveyed on the gripper cylinder, pressed against the shell face, and a release position, in which the flat material can be released again, or a fresh piece of flat material can be picked up and clamped. In general, the grippers perform a pivot movement between these two positions. Since the periods of time available for clamping or releasing of a product are short, the pivot movement must be performed at a high speed and the movement amplitude between the clamping position and the release position of the gripper should be as small as possible in order to maintain strong accelerations, which stress the material, within limits.

In order to prevent damage to a trailing end of a piece of flat material, which is maintained on the cylinder by a gripper, by the movement of a gripper which, in the course of clamping a following piece of flat material, follows in the circumferential direction of the cylinder, most gripper cylinders are laid out for picking up pieces of flat material

which are fed to the gripper cylinder spaced apart from each other, so that the pieces of flat material respectively come to rest against the gripper cylinder while forming a gap between successive pieces, and the gripper can move in the gap without touching the respectively previous piece. If these flat pieces were previously produced by being cut off a continuous web, for creating such a gap the cut-off pieces must be accelerated to a speed which is greater than that of the continuous web prior to cutting. However, if a conveying system, which conveys the products cut off the continuous web further after cutting, runs faster than the fed-in continuous web, this results in slippage and therefore friction between the conveying system and a leading section of the continuous web penetrating it which, prior to being cut off, necessarily still moves at the original speed of the continuous web. In connection with flat material with a sensitive surface, such as freshly printed products, for example, this friction can impair the quality of the surface, for example by means of drag marks or smudging of the ink. Moreover, if the pieces of flat material are put together from a stack of sheets which are not connected with each other, the problem arises that different friction between different sides of the stack can lead to the sheets being displaced in respect to each other and the stack being pulled apart, which makes the further processing of the stack considerably more difficult.

It is particularly problematical if the pieces of flat material are cut off the continuous web when they are in direct contact with the gripper cylinder, for example by means of a rotating cutter cylinder which, together with the gripper cylinder, defines a cutting gap and severs the

continuous web while working together with a counterthrust element of the gripper cylinder. So that the continuous web to be cut is placed evenly against the surface of the gripper cylinder, the gripper must be capable of dipping into the interior of the gripper cylinder. After a piece of flat material has been cut off the fed-in continuous web, there is only a brief period of time available for gripping the freshly created leading edge of the continuous web by means of a gripper and to press it against the surface of the cylinder. However, the path between the lowered position of the gripper and the extended position, which presses the flat material against the cylinder, is long and requires a high speed of the gripper movement, which can only be realized by means of a high quality expensive drive mechanism. Moreover, wear, and therefore susceptibility to failure, of the drive mechanism is the higher, the greater the operating speed is.

A gripper cylinder is known from EP 0 931 748 B1 and DE 198 57 507 A1, which is capable of conveying printed products cut off a fed-in continuous web without a lead, i.e. without a space between the successive printed products. With this gripper cylinder, a gripper is mounted on a shaft, which is pivotably seated via a translation mechanism in the cylinder, which drives the gripper coupled to the pivot movement to perform a parallel displacement. This translation mechanism is used to displace the gripper between its lowered position and a position projecting past the shell face of the cylinder, from which it can be pivoted around the shaft in order to press the leading edge of a continuous web of printed products against the cylinder surface.

DE 100 60 713 A1, USP 6,093,139 A and USP 953 063 A each describe a folding apparatus with a gripper cylinder having a cutter strip for a cutter of a cutter cylinder working together with the gripper cylinder. The grippers of the gripper cylinder are pivotable around a first movable shaft for clamping the material to be transported. This first shaft is in turn seated on a lever, which is pivotable around a second shaft fixed in place on the cylinder. This lever is controlled with the aid of a first cam disk for creating a movement of the gripper in the circumferential direction. A second cam disk controls the clamping movement of the gripper.

DE 102 03 059 A1 discloses a transport cylinder with a gripper for sheets of imprinted material. The gripper can be moved by means of two pivot shafts fixed in place on the cylinder and a further pivot shaft, which is pivotable around one of the pivot shafts fixed in place on the cylinder. Only one cam disk is provided for control.

The object of the invention is based on creating a cylinder of a folding apparatus with a cylinder body and at least one gripper, whose two-stage movement takes place with little stress of the mechanical components and with high accuracy.

In accordance with the invention, this object is attained by means of the characteristics of claims 1 or 2.

The same as the gripper cylinder known from EP 0 931 748 B1, the instant gripper cylinder makes use of a translatory movement, in addition to the pivot movement, for shortening the movement between the retracted position and the clamping position of the gripper, but with the difference

that a mechanism for driving the translation is not pivotable, together with the gripper, around the pivot shaft of the latter and in this way increases its moment of inertia, but instead shifts the shaft of the gripper as such in the radial direction. Since the radial lift required for clamping or releasing the flat material from the gripper cylinder is small in comparison to the required movement amplitude of the gripper in the circumferential direction, a small amplitude of the radial shifting movement is sufficient, which can be generated with a small outlay of energy and little stress on the mechanical components.

If the flat material to be clamped by the gripper is a stack of sheets, it is desirable to avoid a movement component of the gripper in the circumferential direction of the cylinder at the moment of clamping the stack, so that the stack is not subjected to shear forces. While customarily the clamping is created only by a pivot movement of the gripper, so that therefore the exertion of a shearing force on a stack of sheets during clamping cannot be avoided, with the instant gripper cylinder it is preferably provided that the first shaft is moved radially inward in a final phase of the pivot movement into the clamping position.

A simple and rugged possibility for driving the radial inward movement of the first shaft is to mount the latter on a first arm, which is pivotable around a second shaft, which is pivotable in respect to the cylinder body, so that the radial movement of the first shaft corresponds to a pivot movement of this first arm.

The same as the customary pivot movement of the gripper itself, this pivot movement of the first arm can be driven in

a simple manner by a cam disk, which does not rotate together with the gripper cylinder and whose shape is traced by a lever connected with the first arm.

A coupling rod is provided for driving the pivot movement of the gripper between the lowered position and the clamping position, one end of which is hinged on the gripper and the other end on a second arm, which is pivotable around a third shaft. As stated above, its pivot movement can also be driven by a cam disk.

In a space-saving arrangement, the second and third shafts are on opposite sides of the gripper in respect to the circumferential direction of the cylinder.

Of the two arms, the first is oriented more in the circumferential direction, and the second more in the radial direction of the cylinder body, in other words, the orientation of the first arm is respectively closer to the circumferential direction than that of the second, and that of the second closer to the radial direction than that of the first.

A counterthrust element is assigned to each gripper on the cylinder body which, working together with a cutter moved together with the gripper cylinder, is used for cutting flat material fed to the gripper cylinder and to be grasped by the gripper.

In relation to the direction of rotation of such a gripper cylinder, the gripper is arranged upstream of the counterthrust element assigned to it, and the surface cross section of the gripper cylinder, against which the gripper presses cut flat material, preferably is its counterthrust

element itself, whose elasticity aids the cutting process, as well as the gripping process.

An exemplary embodiment of the invention is represented in the drawings and will be explained in greater detail in what follows.

Shown are in:

Fig. 1, a schematic representation of a transverse folding apparatus utilizing a gripper cylinder,

Fig. 2, an enlarged partial sectional view through the gripper cylinder, which shows the gripper in its lowered position,

Fig. 3, a partial sectional view analogous to that in Fig. 2, which shows the gripper in the course of being retracted from the lowered position,

Fig. 4, a partial sectional view showing the gripper in the clamping position,

Fig. 5, a partial sectional view showing the gripper on the return travel to the lowered position,

Fig. 6, a schematic representation corresponding to Fig. 2,

Fig. 7, a schematic representation corresponding to Fig. 4,

Fig. 8, a schematic representation corresponding to Fig. 5,

Fig. 9, a schematic representation corresponding to Fig. 1,

Fig. 10, a schematic view from above on a gripper cylinder.

A greatly schematized sectional view through a folding apparatus, for example of a web-fed rotary printing press in

accordance with the instant invention, is represented in Fig. 1. The folding apparatus comprises a cylinder 01, for example a gripper cylinder 01 which, in the example represented here, is equipped with respectively five grippers 02, evenly distributed in the circumferential direction, and folding blades 03. Preferably a plurality of these grippers 02 is arranged, for example, individually sprung in the axial direction of the cylinder 01. Together with a cutter cylinder 04, here with two cutters 06, the gripper cylinder 01 constitutes a cutting gap 09, in which a fed-in flat material 07, for example a continuous web 07, which generally is composed of a plurality of imprinted webs of material placed on top of each other, for example paper webs, is separated into individual flat materials 08, for example individual printed products 08, each of a length corresponding to a printed page.

In the course of passing through the cutting gap 09, the grippers 02 and the folding blades 03 have been lowered into the interior of the gripper cylinder 01. The circumferential speed of the gripper cylinder 01 exactly corresponds to the feeding speed of the continuous web 07, so that the printed products 08 cut off the continuous web 07 follow each other without gaps on the circumference of the gripper cylinder 01, i.e. there is no relative movement between the lower part of the web of material and the barrel of the gripper cylinder 01.

"Exactly" and "no" should be understood in the technical sense, i.e. negligible tolerances can possibly occur.

Following the passage through the cutting gap 09, the grippers 02 are respectively moved out of the gripper cylinder 01 below the trailing section 11 of one of the printed products 08 and are pivoted in the direction of rotation opposite that of the cylinder in order to clamp the respective leading edge 12 of the continuous web 07 against the surface of the gripper cylinder 01. Thus, the trailing ends 11 of each printed product 08 are spread away for some distance from the surface of the gripper cylinder 01, however, this does not hamper the even winding of the continuous web 07 on the gripper cylinder 01, since they are only spread away from the gripper cylinder 01 after having been cut off.

The gripper cylinder 01 constitutes a folding gap 13 together with a folding jaw cylinder 14. In the course of the passage through the folding gap 13, the folding blades 03 are moved out of the gripper cylinder 01 in order to insert the printed products 08 along a center line into folding jaws (not represented) of the folding jaw cylinder 14. The printed products 08, which are transversely folded in this way, are further conveyed on the folding jaw cylinder 14 to a location where they are transferred, for example, to a (not represented) bucket wheel for delivery onto a conveyor belt.

In a partial sectional representation transversely in respect to the shaft, Fig. 2 shows a gripper 02 and its surroundings. The gripper 02 comprises a support beam 16, which extends over the entire usable width of the gripper cylinder 01 and has a double-L or double-Z profiled element 17 made of an elastic material, such as spring steel, on a radially outward directed side, which can be extended out for

clamping the printed products in place. The profiled element 17 can extend continuously in the axial direction of the gripper cylinder 01, or can be divided into a plurality of tines spaced apart in the axial direction, which respectively extend through an opening in the shell face of the gripper cylinder 01.

On one end the support beam 16 is hinged to a first arm 19, which is fixedly connected with a shaft 21, which is rotatably seated in the gripper cylinder 01, i.e. is stationary in the cylinder. The first arm 19 extends approximately parallel in respect to the shell face of the gripper cylinder 01. The support beam 16 is furthermore hinged by means of a pivot shaft 28, whose position relative to the gripper cylinder 01 can be changed, to a coupling rod 22, which is also oriented approximately parallel in respect to the shell face of the gripper cylinder 01, and which itself is hinged by means of a pivot shaft 29, whose position relative to the gripper cylinder 01 can be changed, to an approximately radially oriented second arm 23. This second arm 23 is fixedly connected with a shaft 24, which is rotatably seated in the gripper cylinder 01. The rotated position of the two arms 19, 23 is, as represented in Figs. 6, 7 and 8, fixed by means of two cam disks 31, 32, which do not rotate together with the gripper cylinder 01 and are traced by respective rollers 33, 34, which are respectively connected by means of an arm 36, 37 with the shaft 21 or 24.

The rollers 33, 34 are preferably resiliently pressed against the cam disks 31, 32, in particular by means of a torsion spring. The cam disks 31, 32 are arranged offset in the axial direction.

It is easy to see by means of Fig. 2 that a rotation of the arm 19 around the shaft 21 substantially causes a radial inward or outward movement of the gripper 02, and at most to a lesser degree a pivot movement of the gripper 02 around a shaft 27 to which the support beam 16 and the first arm 19 are hinged. But a rotation of the shaft 24 would - with the shaft 21 assumed to be fixed - drive a pivot movement of the gripper 2 around the shaft 27.

Therefore a two-stage movement is possible by means of the two cam disks 31, 32. The cam disks 31, 32 have the effect that the pivot movement and the clamping movements of the gripper 02 can each take place substantially independently of each other.

The gripper cylinder 01 represented in part in Fig. 2 rotates in a counterclockwise direction. A hard rubber strip, the surface section 26, has been inserted in the clockwise direction behind the opening in the cylinder shell receiving the profiled element 17, which is used, for example, as a counterthrust element 26 extending in the axial direction for the cutter 06 of the cutter cylinder 04 when cutting the continuous web 07. In the movement direction of the cylinder 01, the gripper 02 is arranged directly in front of the counterthrust element 26 for cutting. The distance a between a tip of the gripper 02 in the lowered state and of an edge of the counterthrust element 26 is less than 30 mm, in particular less than 10 mm. In the configuration represented in Fig. 2, in which the gripper 02 has been lowered into the interior of the gripper cylinder 01, the gripper 02 can pass through the cutting gap 09, wherein the continuous web 07 (not represented in Fig. 2) is cut through

at the height of the counterthrust element 26. For grasping the leading edge 12 of the continuous web 07 being created in the process and for pushing it against the counterthrust element 26, the gripper 02 is moved out of the gripper cylinder 01.

Fig. 3 shows an intermediate position in the course of the moving-out process. As can be seen, the shaft 21 has been clearly rotated in a counterclockwise direction between the configuration of Figs. 2 and 3, because of which the shaft 27 has been displaced radially outward and the profiled element 17 of the gripper has risen through the opening in the cylinder shell. By means of a slight turning of the shaft 24 in the clockwise direction, the gripper 02 has furthermore been pivoted around the shaft 27 in a clockwise direction, so that the tip of the free leg 18 of the profiled element 17 is located radially above the counterthrust element 26.

As represented in Fig. 4, the shaft 27 of the gripper 02 is again radially displaced into the interior of the gripper cylinder 01 by a rotation of the shaft 21 in a clockwise direction, so that the free end of the profiled element 17 is lowered onto the counterthrust element 26 and in the process clamps the leading edge of the continuous web 07 (not represented in the drawing figure) located between itself and the counterthrust element 26.

Following the passage of the gripper 02 through the folding gap 13, the gripper 02 is raised again by means of a rotation of the shaft 21 in a counterclockwise direction, and the printed product 08 clamped between the free end and the counterthrust element 26 is released, as shown in Fig. 5.

From this state the shaft 24 pivots in a counterclockwise direction around the free leg 18 in order to pull the gripper 02 over the counterthrust element 26 and over the opening in the cylinder shell. By means of a subsequent rotation of the shaft 21 in a clockwise position, the gripper 02 is again pulled back into the interior of the gripper cylinder 01 into the position indicated in Fig. 2. Now the gripper 02 is ready for a further passage through the cutting gap 09.

As can be seen, a narrow pivot angle of the gripper 02 is sufficient for being able to move it between the clamping position and the lowered position, and the radial lift is also limited - depending on the thickness of the printed products 06 to be processed - to a few millimeters. Since the gripper 02 can be simply constructed, its weight and moment of inertia are low. The short lifts between the lowered position and the clamping position of the gripper 02 require small accelerations and therefore reasonable, material-saving driving forces.

Fig. 9 shows a gripper cylinder 01 with three gripper systems 02, for example grippers 02, wherein the gripper system 02 located in the area of the cutter cylinder 04 is in the lowered position, i.e. in the cutting position, and the gripper system 02 located in the area between the cutter cylinder 04 and the folding jaw cylinder 14 is in the closed position, i.e. in the clamping position, and the gripper system 02 arranged downstream of the folding jaw cylinder 14 is in the opened position, i.e. in the release position.

A tape guide can additionally be arranged between the cutter cylinder 04 and the folding jaw cylinder 14. These tapes press the cut-off printed products 06, i.e. the

signatures, against the shell face of the gripper cylinder 02. Several tapes are arranged spaced apart in the axial direction, so that the grippers 02 can run without interference in these spaces.

The tape guidance can be driven respectively from the gripper cylinder 01 or the folding jaw cylinder 14. However, the tape guidance can also be driven by frictional connection or by its own separate motor.

Fig. 10 shows a schematic view from above of a gripper system 02.

List of Reference Symbols

01	Cylinder, gripper cylinder
02	Gripper system, gripper
03	Folding blade
04	Cutter cylinder
05	-
06	Cutter
07	Flat material, continuous web
08	Flat material, printed product
09	Cutting gap
10	-
11	Section, trailing
12	Edge, leading
13	Folding gap
14	Folding jaw cylinder
15	-
16	Support beam
17	Profiled element
18	Leg
19	Arm
20	-
21	Shaft
22	Coupling rod
23	Arm
24	Shaft
25	-
26	Surface section, counterthrust element
27	Shaft

28	Pivot shaft
29	Pivot shaft
30	-
31	Cam disk
32	Cam disk
33	Roller
34	Roller
35	-
36	Arm
37	Arm
a	Distance